

## CONTAINER SECURITY SYSTEM

### Field of the Invention

The present invention relates to security devices for storage containers, 10 and more particularly, to a sensor device for indicating the status of a storage container between secured state and a breached state by monitoring environmental conditions within the storage container for changes.

### Background of the Invention

15 Storage containers of the type used in the trucking and shipping industries have had serious problems with unauthorized access, to which significant attention has recently been paid. Much of this attention, however, has focused on preventing access to the storage containers by providing better and stronger locking means. Given the 20 extensive amount of time that the storage containers may be in transit on ships, trucks and sitting in customs areas, the majority of these locks simply provide a false sense of security as they can be easily defeated given the extended time an individual would have in order to overcome the lock.

25 Additionally, oftentimes the breach to the storage container may go unnoticed and there is no way to determine that the breach occurred without inspecting the inside of the container. Furthermore, with the increase in terrorist and criminal activity, it is necessary to be able to detect certain types of radiological weapons that may attempt to be transported illegally through storage containers.

5           Thus, there is a need for a device which can monitor the environment inside, and immediately surrounding the storage container to determine that a breach has occurred, the type and date of breach, notify authorities that a breach has occurred. Also there is a need to determine if potentially dangerous or hazardous cargo is being transported.

10         Accordingly, it is therefore an object of the present invention to provide a sensor device capable of sensing a breach of a storage container and recording information as to the type of breach, the time and date when the breach occurred and transmitting the breach data to authorities.

15         It is another object of the present invention to provide a sensor device capable of sensing environmental changes within a storage container, such as changes in light, heat, motion, pressure, and radiation to determine a potential unauthorized access of the storage container.

20         It is another object of the present invention to provide a sensor device capable of transmitting information about a specific storage container to a global positioning system to notify authorities of a possible breach of the storage container.

It is another object of the present invention to provide a sensor device incorporating visual indicators carried on the exterior of the storage container for displaying the current security status, breached or secure, of the storage container.

Finally, it is an object of the current invention to provide a sensor device capable of receiving and transmitting data as to the contents, origin and destination of a storage container.

### **Summary of the Invention**

The above objectives are accomplished according to the present invention by providing a sensor device capable of detecting a breach of the storage container and recording information as to the type, time and date of breach. The sensor device 10 includes various sensors capable of detecting environmental changes in light, heat, motion, temperature, pressure, and radiation. Preferably, the sensor device is capable of transmitting information to a global positioning system to notify authorities of a breach. In order to indicate a breach of the container to an inspector, the sensor device incorporates visual indicators displaying the current status of the storage container. In 15 a further advantageous embodiment, the sensor device is capable of receiving and transmitting data as to the contents of the storage container, as well, as the type, time and date of a breach to the storage container.

### **Description of the Drawings**

20 The construction designed to carry out the invention will hereinafter be described, together with other features thereof. The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

25 Figure 1 shows a set of storage containers including a sensor device capable of sending and receiving information according to the invention;

5       Figure 1a shows an exploded exterior view of the sensor according to the invention;

Figure 2 is a side view of the sensor device according to the invention;

Figure 3 is a front view of the sensor device according to the invention;

Figure 4 is a rear view of the sensor device according to the invention;

10      Figure 5 shows a schematic representation as to the interaction between the environment in the storage container, the detection of changing conditions by the sensor device, and the visual indicators of the sensor device representing the status of the container according to the invention;

Figure 6 is a schematic of the sensor device according to the invention;

15      Figure 7 is a flow chart depicting the various conditions that control the visual indicators of the sensor device according to the invention;

Figure 8 is a flow chart showing the interaction between the sensor device and a wireless device for transmitting data according to the invention; and

20     Figure 9 shows a flow chart of the software used by the wireless device to interact with the sensor device according to the invention.

### Description of a Preferred Embodiment

Referring now to the drawings, the invention will now be described in more detail. As is illustrated by Figure 1, a plurality of storage containers 10 are shown in stacked alignment. Each of the storage containers includes a sensor device, 10 designated generally as 42, for monitoring changes to the environment inside the storage container. The sensor device indicates the status of the storage container as being in a secured state or a breached state based on changes, or lack thereof, in the environmental conditions inside the storage container. When the storage container is closed and the sensor activated, it is presumably in a secured state 15 with the environmental conditions remaining within a specific range accepted by the sensor device. When a change in the environmental conditions within the storage container occurs, any changes such as a change in light, heat, motion, pressure, or radiation, beyond the specified accepted range is registered by the sensor which then indicates a breached state, preferably using a visual indicator. As is discussed 20 in further detail below, sensor 42 also includes the ability to store electronic information about the contents within the storage container and information as to a breach of the storage container.

In the shown arrangement, sensor 42 is mounted in the upper right hand corner of container door 44. In this location it is easily visible to an inspector 43 who can 25 request status and manifest information through wireless device 46 from sensor 42. Preferably, as is depicted in Figure 1a, sensor 42 includes a visual indicator 48 which

5 immediately indicates to an inspector the current status (secured or breached) of the storage container. In this manner, inspector 43 may simply glance at a stack of storage containers and determine from the visual indicators of the sensor if there has been a breach to any one of the storage containers.

Referring to Figure 2, the sensor includes a housing 50 which is mounted in  
10 container door 44 (Figure 1). A first end of housing 50 forms an external indicator portion 56 which is carried on the exterior side of the storage container and includes the visual indicator 48. The exterior of housing 50 includes threads 64 which receive complementary threads from a locking collar 58. Collar 58 secures housing 50 to container door 44 by tightening collar 58 against the interior side of door 44 which pulls  
15 flange 57 of external indicator portion 56 tight against the exterior side of container door 44. Once the collar has been sufficiently tightened, set screw 60 is secured against housing 50 to prevent lock collar 58 from backing off in order to maintain the tight fit with container door 44. In this fashion, sensor 42 cannot be removed from the storage container without first gaining entry to the container itself and loosening collar 58.  
20 Housing 50 includes various computer hardware and software components, as well as a power supply for operating the sensor device, which are described in detail below.

Referring to Figures 2 and 4, sensor 42 includes a sensor cap 52 carried at a second end of housing 50 opposite external indicator portion 56, secured in place on the end of the housing by threads 64. Sensor cap 52 includes various sensors  
25 commonly known to a person skilled in the art for monitoring the environment inside an enclosed area, and in the case of a radiation sensor, even monitoring the area

5 immediately surrounding the area for radiation. In the preferred embodiment, sensor cap 52 contains a sensor for detecting a change in any user defined variable or a change in conditions outside a specific predetermined range. For example a sensor for changes in light, heat, motion, radiation, pressure, or sound, where the change could be any deviation from a norm, or a change that falls outside a given range, such as a  
10 temperature range. The above examples are provided for illustrative purposes of the preferred embodiment and are not exclusive. Any sensor used to monitor a change in environmental conditions may be used and is considered within the spirit and scope of this invention.

As depicted in Figure 2, sensor cap 52 includes a sensor dome 54 into which  
15 any of the aforementioned sensors extend and receive various environmental information from the storage container. The extended sensor dome 54 allows the sensor to receive the maximum sensory information from the container environment. Preferably, the sensor dome is made from a durable plastic material that allows the sensors to remain protected, while still allowing for limited interference in detecting  
20 environmental changes within the container.

Additionally, it is advantageous to provide the sensor with an external global positioning system (GPS) port 62 as shown in Figure 2. This allows the sensor to monitor the current location of the storage container and transmit current status information, or in the event of a breach, to notify authorities of a breach. It is to be  
25 understood that the storage container must be equipped with the proper GPS

5 transmitting equipment, well known in the art, to take advantage of the GPS port contained within the sensor device.

Referring to the external portion 56 of the sensor, as shown in Figure 3, a plurality of visual indicators are provided. In the preferred embodiment a single green light 68 is provided which flashes to indicate a secured state. In the event of a breach 10 detected by the sensor device, blue indicator light 66 will flash to notify the inspector that the container was breached or a condition otherwise occurred to cause the sensor to indicate a change in condition. Additionally, external portion 56 includes an infrared port 18 which transmits and receives information from a wireless device 46, as shown 15 in Figure 1 and as discussed below.

15 Referring to Figure 5, once the storage container is loaded and the sensor activated, the environment, designated generally as 150, inside the container will be monitored for changes in heat, motion, radiation, light and pressure. If for example, the sensor were to detect a sudden change in light as a result of someone opening a door to the storage container or drilling a hole in the side of the container, the sensor would 20 register that change and send a signal to the indicator light 66 which would begin to flash blue. The visual indicator would continue to flash blue until an inspector examined the container and determined that the sensor could be reset. The inspector transmits a security code verifying the authority to reset the sensor and activate green 25 flashing light 68.

25 Referring now to Figure 6, a schematic of the invention is shown. Central processing unit (CPU) 10 is in communication with a compute readable medium 12. A

5 set of computer readable instructions is embodied within computer readable medium 12 which functions to provide a norm against which the sensed information is compared to and provides the functionality for this invention. Sensors 14 are in communication with said computer readable medium either directly or through processor 10. Preferably, sensors include light sensor 14a, heat sensor 14b, motion sensor 14c, radiation sensor  
10 14d, and pressure sensor 14e in any combination thereof or individually carried by sensor cap 52, or within housing 50 of the sensor 42. These sensors are able to monitor the respective environment conditions within the container and indicate whether light, heat, motion, radiation, or pressure has changed since the sensor was activated.

These sensors supply a signal to CPU 10 that can be used to and  
15 communicated to the computer readable medium 12. Visual indicators 48 are in communication with either CPU 10, computer readable medium 12, or both and provide external indications when actuated. Preferably, the indicators are flashing lights, but may include sound and/or motion creating devices to indicate the current status of the storage container. For example, an indicator can show the color green for a normal  
20 condition with the color blue, red, or other color indicating a different condition than normal. In an example, when sensor 14e detects changes in radioactive radiation emissions, CPU 10, with the assistance of computer readable instructions 12, activates visual indicator 48 to provide for blue flashing light 66 indicating a change from the normal, in this case, the present of a certain radiation level.

25 Infrared port 18 is in communications with CPU 10 and computer readable medium 12 for transmitting and receiving information to and from the computer

5 readable medium. Additionally, other input-output ports 20 can be in communication with CPU 10 and/or computer readable medium 12 such as RS232, serial parallel, radio, or other means of communicating electronic signals. In the preferred embodiment, a GPS system 22 can be in communications with CPU 10 and/or computer readable medium 12. Therefore, computer readable instructions embodied in  
10 the computer readable medium can receive a position signal from GPS 22 and store the location of the container at a particular interval. Power supply 24 can be in communication with CPU 10, computer readable medium 12, GS 22, port 20, IR port 18, indicator 48, and sensors 14 so as to supply them with power. Computer readable medium 12 can also contain manifest or bill of lading information 26 which can  
15 represent the contents of a container. Images 26 can also be included in computer readable medium 12 so as to store images of the contents of the container. Computer readable instructions 30 provide the functionality and embodiment in computer readable medium 12. Computer readable instructions 30 can record events detected by the sensor, such as the existence or changes in light, heat, motion, radiation or  
20 pressure and associate a date, time and location through GPS 22. The computer readable instructions can also record attributes of each sensor such as, for example, the strength, location, the time and date that radiation is detected.

Input device 32 can be in communication with CPU 10 and computer readable medium 12 for inputting and outputting information to and from the computer readable medium. Input device 32 can be a PDA such as a palm pilot, laptop or other device, as illustrated by wireless device 46 in Figure 1, able to transmit signals to and from the

5     CPU 10 and/or compute readable medium 12 through IR port 18 or other input/output  
port 20. Computer readable instructions embodied in the computer readable medium  
are able to detect a sensor signal from sensors 14 representing a change or presence  
of light, heat, motion, radiation or pressure. Upon the sensor detecting such a change,  
the sensors transmit the information to CPU 10, which in turn activates indicator 48  
10    according to the sensor signal.

Referring now to Figure 7, a flow chart is shown depicting the various changes in  
conditions that will switch visual indicator 48 from a green flashing light to a blue  
flashing light to signal a breach of the storage container. At position 70 the sensor  
device is activated and causes the green indicator light to flash indicating a secured  
15    condition, as depicted in step 72. The sensor device will continue to signal a green  
flashing indicator until a change in condition will switch the visual indicator to flashing  
blue lights. As depicted in step 74, a change in light would lead to flashing blue  
indicators representative of a breach of the storage container as depicted in step 76.  
Once a breach occurs, the date, time and type of breach is stored in the sensor device.  
20    Additionally, if the sensor device is connected to a GPS system, it would send a signal  
notifying authorities of the date, time and type of breach and location of the container.  
The sensor device will then continue to monitor for additional changes in condition,  
such as a change in radiation levels at step 82, a change in air pressure at step 84, or a  
change in temperature and motion at step 86. In each of steps 74, 82, 84 and 86 a  
25    change in condition will lead to a flashing blue visual indicator representative of a  
breached status for the storage container requiring the attention of an inspector or other

5 authority personnel. As is clearly depicted by Figure 7, if no breach occurs the indicator will continue to flash green.

In the preferred embodiment, as shown in Figure 1, inspector 43 uses an input device 32, such as wireless handheld device 46, to interact with sensor device 42. Referring to Figure 8, a flow chart is illustrated showing the interaction between the 10 wireless device 46 and sensor device 42. Once the sensor device is activated in step 90, the wireless device may transmit data to the sensor device in step 92. The sensor device will then receive that data as depicted by step 94 and store the data at step 96. As discussed above, this data may include the manifest or various other information about the container. Upon arrival of the storage container, inspector 43 may use 15 wireless device 46 to request the data stored on the sensor device from its origination point, as depicted by step 98. The sensor device then retrieves the stored data including any information relating to a breach of the storage container, as depicted by step 100, and transmits the data to the wireless device through infrared or other wireless communication technology as depicted at step 102. Alternatively, the 20 information can be transmitted through other input/output port 20. If the container was breached, the wireless device may then send a reset code to the sensor device, as depicted in step 104, which will reset the flashing blue indicator lights to the standard green light to indicate a secure condition as represented in step 106. Upon resetting the sensor device through steps 104 and 106, the sensor device's memory may at this 25 point be cleared and ready to receive new or additional information, as represented by step 108.

5 Referring to Figure 9, in the preferred embodiment of the invention, the wireless handheld device 46 used by inspector 43 provides various options for sending and receiving information from sensor device 42. As depicted in step 110, the software for the wireless device is activated to interact with the sensor device. The software program includes a main menu 112 that allows the user to select from a variety of  
10 options. In the preferred embodiment, at step 114, the user may select to send text to the wireless device. In this instance, the wireless device will retrieve the stored text from memory at step 116 and transmit the stored text to the sensor device at step 118. At step 120 the user may select to send handwritten information designated by the term signature at step 120. In this case the user will input the information into the  
15 wireless device by either typing or writing through a user interface at step 122 and the software at step 124 will then transmit the information from the wireless device to the sensor device. Preferably, the user will have the ability to send image files depicting the contents of the storage container. Using this option, at step 128, the user will select an image file from information store don the wireless device at step 130. The user may  
20 also wish to retrieve information stored on the sensor device by selecting the option to read the sensor device at step 132. The wireless device will then transmit a signal to retrieve information stored on the sensor device at step 134 and store the information carried on the sensor device onto the wireless device at step 136. At step 138, the user may select to view the information on the wireless device which will retrieve the  
25 information stored on the device at step 140 and display information about the

5 container, the battery voltage, time, logs, text, signature information, and image files,  
and any breach information, as depicted by step 142.

While a preferred embodiment of the invention has been described using  
specific terms, such description is for illustrative purposes only, and it is to be  
understood that changes and variations may be made without departing from the spirit  
10 or scope of the following claims.

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